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ABSTRACT

In this study the effects of operational level on the quality of children's questions and on their free recall were investigated. Subjects were 65 second-, fourth- and sixth-grade children. Children's operational levels were decided by their performance on nine Piagetian tasks. A question asking task was used to study their question quality. At the end of the tasks session, and one month later, the children were asked to recall stimulus materials based on two Piagetian tasks and on the questions task. Analyses of variance yielded significant F's for all main effects and no significant interaction terms. Implications for instructional intervention are made. One instructional implication of this study is the need to match teachers' questions to children's questions to facilitate their recall of meaningful material. (Author/MS)

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Operational Level, Question Quality and Free Recall in Children

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Abstract

In this study the effects of operational level on the quality of children's questions and on their free recall were investigated. Children's operational levels were decided by their performance on nine Piagetian tasks. A question asking task was used to study their question quality. At the end of the tasks session and one month later the children were asked to recall stimulus materials based on two Piagetian tasks and on the questions task. Analyses of variance yielded significant F's for all main effects and no significant interaction terms. One instructional implication of this study is the need to match teachers's questions to children's questions to facilitate their recall of meaningful material.

Operational Level, Question Quality and

Free Recall in Children

The most common Piagetian technique in the study of young children's thinking is the technique of asking children questions and then following up the logic behind their responses. Sinclair and Kamii (1970) quote Papert as saying that "children always correctly answer the question they ask themselves". They see the observer's job as finding out precisely what those questions are instead of simply recording that the child gave the wrong answer to the adult's question.

In this study my interest is in looking at the developmental characteristics of the "questions children ask themselves." The purpose of studying these characteristics is to find out if the organization of information in children's questions depends on their operational level and if, in turn, this organization influences their recall.

Piaget and Inhelder (1973), in their work on memory and intelligence, suggest that children accurately recall stimuli if there is a match-up between their level of cognitive development and the mental operations required to identify how the stimuli are organized. If children, for example, can independently seriate a set of objects then their memory for a presented pattern of seriated objects is supported by that operational understanding. Their basic hypothesis is that coding used for recall is a dynamic

process which changes in relation to underlying operational structures. If this is true, I wonder if children's questions are indicative of the coding they use and of their underlying operational structures as well.

Previous research (Arlin, 1974, 1975a, 1975b, 1976a, 1976b) provides a basis for this type of study of children's questions. When subjects were presented with a set of objects they were asked to raise as few or as many questions as they could about any object or group of objects in the set. Their questions were then classified using Guilford's products categories (1956). Table 1 gives the operational definitions of the categories and sample questions for each.

Insert Table 1 about here

There is a precedent in verbal learning research on free recall to consider the instructions for the questions task as instructions to organize. Rosner (1971) found that when she gave instructions to look for ways that stimulus items could go together, subjective organization increased with age. The instructions for the questions task are, in fact, instructions to look for ways that the objects go together. Rosner's findings on subjective organization fit nicely into a Piagetian position. For one possible explanation for her findings is the gradual

development of the ability to classify and seriate in concrete operational children. Interestingly, Rosner found that first graders benefited little from her instructions. Since most first graders are, at best, in a transition to concrete operational thought, her finding is consistent with Piaget's theory. Further support for this explanation comes from the work of Tomlinson-Keasey, Crawford and Miser (1975) on classification as an organizing operation for memory. Their findings suggest that the child must have a category (self-generated or supplied) in order to organize material effectively for recall. Possibly the categories used for classifying the quality of children's questions can be used to infer the organizational processes they are using in coding the stimuli for recall.

Problem

The specific questions that I have asked in doing this research are: (1) is a child's operational level predictive of the quality of the questions he/she will ask; (2) can those questions be used to study the child's organizational processes in coding; and (3) are both operational level and question quality predictive of recall?

Method

Sample. Sixty-five second, fourth and sixth grade children participated. Group size (and mean age) were respectively: 21 (M=7.7 years), 25 (M=9.5 years), 19 (M=11.8 years). The

majority were white, middle-class Canadians attending a suburban public school.

Procedures. Each child was given a question asking task and nine Piagetian tasks. The Piagetian tasks were used to assess each child's operational level. The questions task was used to obtain a sample of the child's questions and to provide stimuli for one of the recall tasks. At the completion of the Piagetian tasks the children were given two recall tasks related to two of the Piagetian tasks just completed. One month later the children were asked to recall the same two tasks and a third recall was also requested on the objects used in the questions task.

Piagetian tasks. The nine Piagetian tasks included four conservation tasks (length, area, substance, and volume), three classification tasks (Inhelder & Piaget, 1964, pp. 99ff; pp. 151-161; and pp. 60-64), a combinatorial thinking task (Piaget & Inhelder, 1973, pp. 189-191), and an associative operation task (Piaget & Inhelder, 1973, pp. 116-118). Each task was administered in the manner described by Piaget and his associates and evaluated accordingly. By summing scores across all tasks a composite operational thinking score was obtained. On this basis children were placed in one of three operational levels: low concrete, concrete or transitional (to formal operations). Placement was on the basis of the number of tasks for which the children gave the appropriate operational response. The smallest

group size was 19, therefore 19 children were randomly selected into the remaining two groups. Analyses were performed on these three groups (N=57).

Questions task. The task used was the problem finding task reported by Arlin (1974, 1975a, 1976b). Each child was given ten minutes in which to make up questions about the objects before them on a table. The questions were then transcribed from audio-tapes and classified (See Table 1). This classification was used to measure question quality. Quality is defined as a weighted average of the questions by category. Units questions are given the smallest weight (1) and implications questions, the largest (6).

Recall tasks. The two Piagetian tasks used for two of the recall tasks were the conservation of length and the combinatorial (arrangements) task. In the conservation of length task two parallel lines are constructed with five matches each. One line is then transformed to a zigzag pattern. The child is asked to draw from memory the match sticks before and after the transformation. Recall of the line patterns is directly related to the conservation of the length of a line whose shape has been altered (Piaget & Inhelder, 1973).

The second recall task was the child's remembrance of an arrangement. The arrangement represented a permutation of three things taken two-at-a-time. According to Piaget, permutations

call for a grasp of higher structures based on formal thought, particularly on combinatorial thought. In this task the child is asked for a brief description of what he sees and whether or not the objects are placed in any special way on the paper. The child's description is noted by the interviewer. Then the child is asked to look at the arrangement for as long as he wishes because he will be asked to make a picture of it from memory.

The third recall task involves the memory of the specific objects used as stimuli for the questions task. There are 11 types of objects and all of the objects are within the everyday experience of even the youngest children in the study. The expectation is that the higher the level of organization of the stimuli through the medium of questions, the more accurate the recall.

Results

Two repeated measures analyses of variance were used (operational level × time), one for each of the recall tasks. Significant F's (2,62), $p \leq .005$ were obtained for the main effects in both tasks. No significant interactions were observed.

For the third recall task, based on the questions task, analyses of variance indicated the effects of operational level on recall. A significant F (2,62) of 15.61, $p \leq .001$ was found. Operational level was also predictive of question quality (F = 4.32, $p \leq .05$).

Conclusions and Implications

It appears that operational level is predictive of both question quality and of recall. This is not particularly startling since in part I have replicated two of Piaget and Inhelder's findings in their work on memory and intelligence. If we look more closely at the relation between operational level and question quality we find some very interesting things. Children who are low in concrete operational thinking ask questions in the units, and sometimes, in the classes categories. Relations questions are the common questions of concrete operational children. Systems questions appear late in the concrete stage and are usually supported by thought structures characteristic of individuals making the transition to formal operations. Formal operational thought is a pre-requisite for transformations and implications questions. No child in the study raised a question which could be classified as transformations or implications.

An argument can be made that these categories (units through implications) are ordered along a concrete/abstract dimension and that they can be viewed as involving higher and higher levels of organization of the stimuli. For example, a person who asks a units question exhibits a low level of organization because a units question refers to elements in the stimuli in isolation from each other. A qualitative analysis of the question and recall

data bears this out.

Based on this work there are a number of implications for instructional intervention which can be drawn. Included are:

1. If young children naturally generate "units" or "classes" questions, then the use of such questions in instruction may interact with their operational structures to make coding and recall of information easier for them.
2. If questions are matched to operational level, understanding of concepts may be facilitated.
3. The use of higher order questions may confound rather than stimulate understanding and recall.
4. The questions children spontaneously ask in classroom settings may give the teacher indications of the child's operational level and guide his/her instructional decisions and sequencing of instruction.

These are only inferences from an exploratory study but they may be worth considering for if children "always correctly answer the questions they ask themselves" instructional intervention might be more successful if teachers' questions are matched to children's questions.

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Footnotes

[1]This paper is a revision of a paper presented at the annual meeting of the American Psychological Association, Washington, D.C., September, 1976.

[2]Requests for reprints should be addressed to P. K. Arlin, Ph.D., Department of Ed. Psychology, University of British Columbia, 2075 Wesbrook Terrace, Vancouver, B.C., V6T 1W5.

Table 1

Operational Definitions and Examples for the Guilford Categories

Category	Definition	Example
1. Units	Basic units of information.	"How many objects are there here?"
2. Classes	Simple classifications according to one attribute or dimension.	"Can I group these according to size, or color, or shape?"
3. Relations	Connections between objects or units of information. Connections can be opposition, part-whole, comparisons etc.	"Are these related, this hole in the paper and this 25¢? Can the quarter go through the hole without ripping the paper?"
4. Systems	The hierarchical ordering of classes and/or relations as in problem solving.	"Can you make 4 triangles at once out of these 6 match sticks?"
5. Transformations	The use of the stimuli combined in new ways to create a "whole that is different than or greater than the sum of its parts".	"If you were given this steel thing, What could you change it into? What could you make?"

Table 1 continued

Category	Definition	Example
6. Implications	Abstraction from the given stimuli. Seeking meaning and/or the coordination of several systems or sets of relations.	"In what ways can you arrange these objects on the table to represent how you feel at this moment?"

(Table previously cited in: Arlin, P. K. "Piagetian operations in problem finding." Developmental Psychology, 1976, in press.)